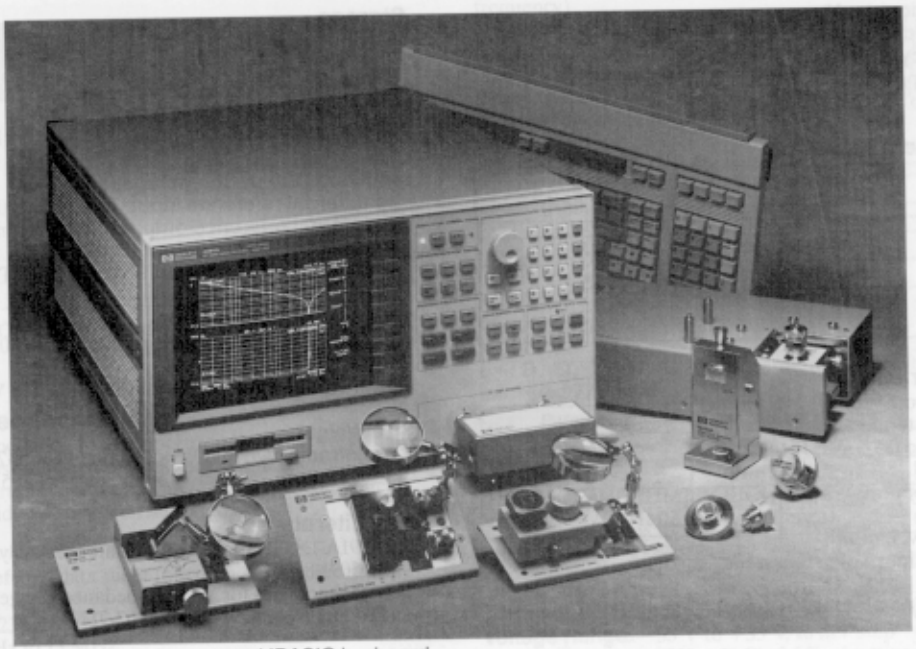
- Basic accuracy ±0.8%
- Advanced calibration and error compensation
- Four component test fixtures (DUT size: 0.5 mm to 20 mm)
- Independent parameter selection in 2 channels
- Direct read-out permittivity, permeability
- Two material fixtures (operating temperature: −55° to +200° C)
- Versatile analysis (temperature, cole-cole plot, relaxation time)
- Swept parameters (frequency, ac level, dc bias, temperature)



HP 4291A with fixtures and IBASIC keyboard

HP 4291A RF Impedance/Material Analyzer

Excellent Performance

The HP 4291A RF impedance/material analyzer provides a total solution for high-accuracy and easy measurement of surface-mount components and dielectric/magnetic materials. The HP 4291A uses a direct current-voltage measurement technique, as opposed to the reflection measurement technique, for more accurate impedance measurement over wide impedance range. Basic impedance accuracy is ±0.8%. High Q accuracy enables low-loss component analysis. An internal synthesizer sweeps frequency from 1 MHz to 1.8 GHz with 1 mHz resolution. A 1.8 m error-less cable connects the analyzer to a test station so you can extend your test point away from the analyzer without losing accuracy. Advanced calibration and error compensation function eliminate measurement error factors in fixtures and assure high accuracy and repeatability at DUT/MUT.

The HP 4291A also provides automatic level control and monitor of test signals by using I-BASIC programing function; devices can be measured under a constant voltage or current. Measure bias-dependent impedance characteristics with optional dc bias (up to 40 V and 100 mA). At the push of a button, the built-in Equivalent Circuit Analysis Function automatically calculates the circuit constant values of five circuit models (similar to HP 4194A's Equivalent Circuit Analysis Function).

The HP 4291A has two measurement channels; each channel can be set to measure a single (e.g., Z) or dual (e.g., Z-theta) impedance parameter. The color CRT with split-display can show both active traces and memory traces (stored in RAM). A built-in floppy disk drive stores programs and test data in either LIF or MS-DOS format.

With optional IBASIC (Opt 1C2), you can control external test equipment such as a temperature chamber or wafer prober directly from the HP 4291A. You do not need a separate instrument controller. Opt 1C2 gives you a keyboard and the HP IBASIC programming language for test automation and integration.

Material Evaluation

The HP 4291A enables easy and sophisticated material evaluation and improves material evaluation quality and efficiency. The HP 4291A provides the total dielectric/magnetic material measurement solutions in wide frequency range (1 MHz to 1.8 GHz). See page 348 for more information.

Key Features

- Direct material parameters read-out (permittivity, permeability)
- Material analysis functions (cole-cole plots, relaxation time analysis)
- Versatile evaluation using a variety of swept parameters (frequency, signal level, temperature, etc.)

Test Fixtures

Select from four types of component test fixtures: HP 16191A, HP 16192A, HP 16193A, and HP 16194A. These test fixtures directly connect to the test station's APC7 connector. Each fixture is designed for a different component size range, from 0.5 mm to 20mm, and can handle different types of termination. These adjustable fixtures simplify device connection. For temperature coefficient testing, the HP 16194A high-temperature component test fixture can be used in a temperature oven from −55° to +200° C. Together with the HP 4291A's built-in compensation software, the fixtures ensure impedance accuracy and measurement repeatability. The HP 16453A dielectric material test fixture and HP 16454A magnetic material test fixture improve the accuracy and ease of use for permittivity or permeability measurements. These material fixtures have wide operating temperature of −55° to +200° C.

For measuring thin-film devices and semiconductors, the HP 4291A easily interfaces to a wafer prober. An extension cable connects the HP 4291A's test head to a probe station. For temperature and humidity testing, the HP 4291A can control an external temperature/humidity chamber via HP-IB and display the measurement result vs. temperature or humidity.

Ease of Use

With the HP 4291A, impedance testing is easy. The analyzer comes with on-line calibration and compensation routine to simplify the task. Markers and limit-line function offer quick data analysis.

IMPEDANCE MEASURING INSTRUMENTS

RF Impedance/Material Analyzer, 1 MHz to 1.8 GHz (cont'd)

HP 4291A

Specifications

Measurement Parameters

Impedance Parameters: |Z|, |Y|, θ, R, X, G, B, Cp, Cs, Lp, Ls, Rp, Rs, D, Q
Converted Parameters: |Γ|, θ, Γx, Γy
Material Parameters: |ε|, θ, ε′, ε″, |μ|, μ′, μ″
Operating Frequency: 1 MHz to 1.8 GHz
Frequency Resolution: 1 mHz
Frequency Reference Accuracy: <±10 ppm/year @ ±5° C
Precision Frequency Reference (Option 1D5)
Accuracy: <±1 ppm/year @ 0° to 55° C, referenced to 23° C

Basic Measurement Accuracy

Frequency (Hz)	Impedance %	Phase (radian)
1M to 100 M	0.8	8 m
200 M	1.0	10 m
500 M	1.5	15 m
1 G	2.5	25 m
1.8 G	4.0	40 m

Source Characteristics

OSC Level: 0.2 mV to 1 V rms [1 MHz to 1 GHz] (Output terminal open) 0.2 mV to 0.5 V rms [1 GHz to 1.8 GHz]
Basic OSC Level Accuracy: 2 dB + 6 dB × f[MHz]/1800 @23±5° C (terminated with 50 Ω) @V_{osc} ≥250mV
Display Level Unit: V, I, dBm
Level Monitor Function: Voltage, current
Connector: APC7
Output Impedance (nominal value): 50 Ω

DC Bias

DC Level: 0 to ±40 V, 0 to ±100 mA
DC Level Accuracy:
Voltage level: 0.1% + 4 mV + (Idc[mA] × 5 [Ω]) mV @ 23 ±5°C
Current level: 0.5% + 30 μ A + (Vdc [V]/10 [kΩ]) mA @ 23 ±5°C
DC Level Monitor Function: DCV, DCI

Sweep Characteristics

Sweep Parameter: Frequency, ac signal level, dc bias voltage/current, (temperature by using I-BASIC)
Number of Measurement Point: 2 to 801 points
Averaging: Sweep average, point average
Delay Time: Point delay time, sweep delay time
Measurement Circuit Mode: Serial circuit mode, parallel circuit mode

Calibration/Compensation

Open/Short/50 Ω Calibration, low loss CAL
Open/Short/Load Compensation, port extension, fixture electrical length

Display

CRT:
Type: Color CRT
Size: 7.5 inch
Resolution: 512 × 400
Number of Display Channels: 2
Format: Single, dual, active + memory, graphic, and tabular

Storage

Type: Built-in 3½-inch floppy disk drive, Volatile RAM disk memory
Disk format: LIF, DOS

Programming: HP Instrument BASIC (Opt 1C2)

Input and Output Characteristics

External reference input: 10 MHz ±100Hz typically
Internal reference output: 10 MHz nominal
Reference oven output (Option 1D5): 10 MHz nominal
External trigger input: BNC female, TTL Level

General Specifications

Operating Temperature/Humidity: 10° to 50° C/15% to 80% RH
Warm Up Time: 30 min
Power Requirements: 90 V to 132 V, or 198 V to 264 V, 47 to 66 Hz, 500 VA max
Size/Weight:
Mainframe: 426 mm W × 234 mm H × 537 mm D / 28 kg
Test station: 275 mm W × 95 mm H × 205 mm D / 3.7 kg

Key Literature

HP 4291A 1.8 GHz Impedance/Material Analyzer Data Sheet, p/n 5091-8596E.
New Technologies for Wide Impedance Range Measurements (Product Note 4291-1) p/n 5962-7177E.

Ordering Information

	Price
HP 4291A RF Impedance/Material Analyzer	$37,750

Options

Opt 1D5 Add High Stability Frequency Reference	+$1,785
Opt 1C2 Add HP IBASIC, HP-HIL Keyboard and Cable	+$1,120
Opt 001 Add DC Bias	+$1,795
Opt 002 Add Material Measurement Software	+$3,365
Opt 011 Delete High Impedance Test Head	−$2,640
Opt 012 Add Low Impedance Test Head	+$2,695
Opt 013 Add High Temperature High Impedance Test Head	+$5,610
Opt 014 Add High Temperature Low Impedance Test Head	+$5,610

Support options

Opt W30 Extended Repair Service	+$925
Opt W32 Calibration Service	+$380

Accessories

HP 16190A HP 4291A Performance Test Kit	$6,185
HP 16191A Side Electrode Test Fixture	$2,475
HP 16192A Parallel Electrode Test Fixture	$1,980
HP 16193A Small Side Electrode Test Fixture	$2,225
HP 16194A High-Temperature Component Test Fixture	$2,475
HP 16453A Dielectric Material Test Fixture	$4,715
HP 16454A Magnetic Material Test Fixture	$3,535

Key Specifications of Test Fixtures

Type of fixture	HP 16191A	HP 16192A	HP 16193A	HP 16194A
Operating frequency (typ.)		dc to 2 GHz		dc to 2 GHz
Operating temperature		−55° to +85° C		−55° to +200°C
DUT size (length: mm)	2.0 to 12.0	1.0 to 20.0	0.5 to 3.2	2.0 to 15.0